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(51) INT CL⁴
F16L 55/12

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(56) Documents cited

GB A 2094862	GB 1580438	GB 0807413
GB A 2084686	GB 1553408	EP 0060670
GB A 2018384	GB 1437273	EP 0000576
GB A 2003576	GB 1340068	

Note: GB A 2094862 and EP 0060670 are equivalent;

(58) Field of search
F2P
Selected US specifications from IPC sub-class F16L

(54) Lining pipes

(57) A thermoplastic conduit 10 is heated a sufficient amount to make it pliable and while in this state its dimension in cross section is reduced (Fig. 2, not shown). It is inserted in this reduced dimension and in a pliable state into a pipe 14 to be lined (Fig. 4, not shown). It is then expanded eg. by a heated mandrel 52, by hot water or steam passed down the conduit 10 or between plugs (30, 32, Fig. 5 not shown) and when set serves as a rigid or semi-rigid liner. In a preferred process, the liner or conduit 10 of P.V.C. upon being reduced in dimension is wound on a roll and is unwound from such roll during installation in a pipe.

FIG.6

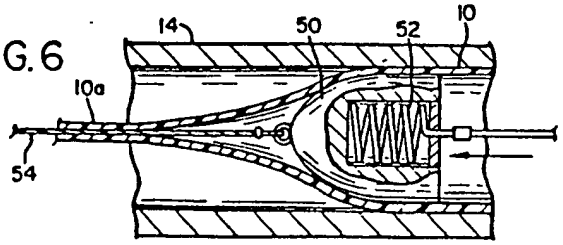

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FIG. 1

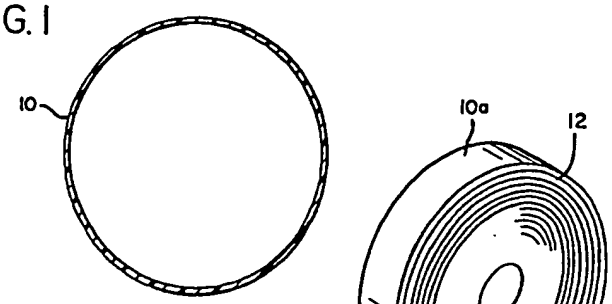


FIG. 3

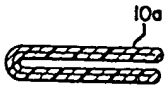


FIG. 2

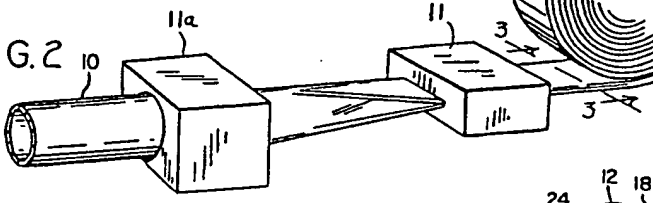


FIG. 4

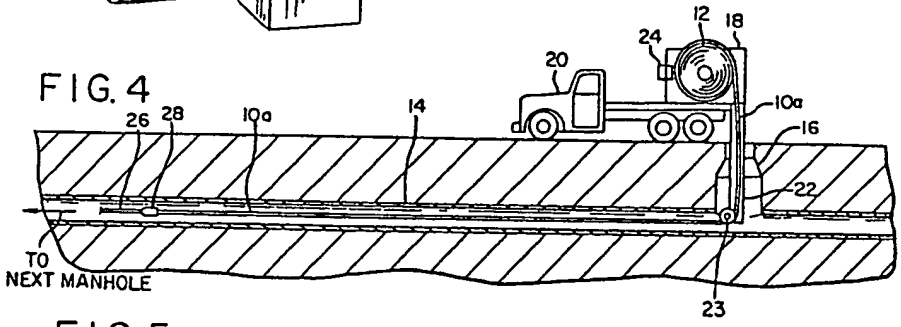


FIG. 5

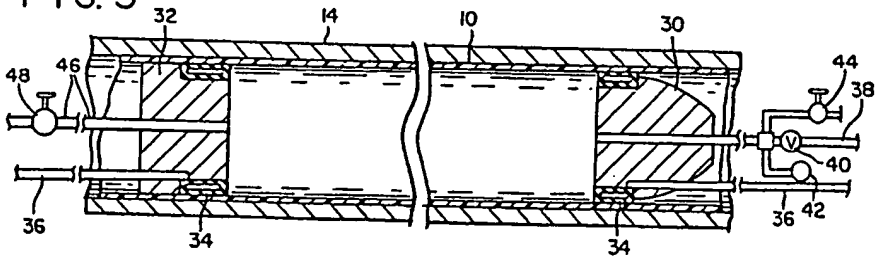
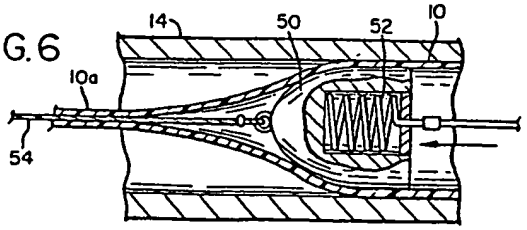


FIG. 6



SPECIFICATION

Process and apparatus for lining a pipe

Background of the Invention

This invention relates to a new and useful improvement in a process and apparatus for lining a pipe.

It has heretofore been known to repair pipe lines, such as underground sewer lines or the like, by applying an inner liner to the pipe from spaced points so as to stop leaks without the necessity of excavating the entire pipe line. In one process, pipes have been lined with a flexible plastic such as polyethylene. This process has disadvantages in that the liner reduces the effective pipe diameter substantially and also holes must be dug frequently along the pipeline in order to install the polyethylene. This makes the polyethylene process rather expensive. Another process that has been used is the type shown in U.S. Patent Nos. 3,927,164 and 4,064,211 wherein the flexible tube is turned inside out as it is inflated into the pipe. This process is also expensive because it requires special equipment to install. Since these prior processes are relatively expensive, they are limited in their application.

Summary of the Invention

According to the present invention and forming a primary objective thereof, a process and apparatus for lining a pipe are provided that are more economical in installation than prior processes in that said process and apparatus use relatively inexpensive and readily available tubing and tubing which is readily applied to the interior of a pipe with minimum excavation. Furthermore, the lining is of substantially thick walls and can fit tightly against the wall of the original pipe. Also the present liner will last indefinitely and serve as a conduit itself so as to withstand external pressure.

In carrying out the objectives of the invention, conventional polyvinyl chloride (PVC) tubing or similar semi-rigid plastic tubing having thermoplastic characteristics, is first subjected to heat and then the cross section dimension thereof reduced such as by flattening and/or folding it. This product while reduced in dimension is reheated and installed in a pipe to be lined. For initial preparation of the tubing and for storage, it can, while in its reduced condition, be wound on rolls, and then when it is to be applied to a pipe, it is again heated, to make it pliable, and pulled into the pipe. Thereupon, the reduced tubing is expanded by applying a heated expanding force to its interior.

The invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a sectional view of conventional thermoplastic tubing, such as PVC tubing;

Figure 2 is an elevational view of the thermoplastic tubing of Fig. 1 and apparatus for reducing the dimension of the tubing;

Figure 3 is a cross sectional view of the thermoplastic tubing as reduced in cross section in an initial step of the present process, this view being taken on the line 3–3 of Fig. 2;

Figure 4 is a diagrammatic view showing application of the present tubing to an underground pipe, the reduced thermoplastic tubing being stored on a roll and being reheated for installation in the underground pipe to be repaired;

Figure 5 is a diagrammatic view showing a detail of structure for expanding the reduced tubing and rounding it into a liner after it has been inserted in the underground pipe; and

Figure 6 is a diagrammatic view showing an alternative structure for rerounding and expanding the flattened tube.

Detailed Description of Preferred Embodiments

With reference first to Fig. 1, the numeral 10 designates a type of tubing which is used to line underground pipes or the like according to the present invention. A characteristic of the tubing 10 is that it is formed of thermoplastic material and more particularly a material that is normally rigid and thick walled and can be made pliable upon heating and then reheated after once it has set up whereby to again be made pliable, and also to set up a final time to form a rigid or semi-rigid lining. A conventional and readily available tubing of this type comprises polyvinyl chloride (PVC) conduit presently available for underground lines such as drain lines, water lines, etc.

Fig. 2 illustrates apparatus 11 for shaping the conventional tubing 10 according to the present invention, and Fig. 3 illustrates in cross section the reduced shape thereof. More particularly, the PVC pipe 10 is heated in any conventional manner, such as by heating means 11a, to a sufficient temperature to make it pliable. It is then flattened and/or folded, by conventional apparatus 11, whereby to reduce its overall cross section dimension so that it is capable of being pulled into an underground pipe or the like in its reduced shape. The reduced dimension liner is designated by the numeral 10a, and although it can possibly have use in a one step flattened condition, it is preferred that it be flattened and then folded as shown in Fig. 3 so that its widest cross sectional dimension is considerably less than the original round shape.

The reduced dimension tubing 10a can then be stored in its folded condition, and prefera-

bly, it is wound while still pliable onto rolls 12. Fig. 4 also shows installation of a pipe liner according to the invention, as will now be described.

Equipment for installing the reduced tubing in an underground pipe 14 or the like having spaced manholes 16, comprises an enclosure or shroud 18 with conventional mechanism for rotatably supporting a roll 12 of the present reduced tubing. Enclosure 18 can be mounted on a transporting vehicle 20 and has a depending spout 22 from which the reduced tubing can feed. The bottom end of the spout has a guide roller 23 for efficient angle feeding of the tubing. Enclosure 18 has heating means 24 associated therewith of a conventional type and capable of heating the roll 12 to a pliable state so that the tubing 10a can be unrolled therefrom.

According to the invention, the enclosure 18 is transported to an opening, such as a manhole 16, at a pipe section 14 to be repaired. The end of the reduced tubing 10a is connected to a pull line 26 made available from an adjacent opening in the pipe, such as another manhole, and connected by clamp means 28 to the free end of the tubing. The tubing is made pliable from heating by heater 24 and the pull line 26 then activated to pull it through the pipe. After inserting the tubing it is then heated and expanded to a round or substantially round form to provide a liner which will set up into a thick walled, rigid or semi-rigid structure.

Fig. 5 illustrates one manner of expanding the reduced dimension tubing after it has been pulled into the pipe to be lined. Such comprises a pair of plugs 30 and 32 installed at opposite ends of the reduced tubing, namely, the plug 30 being installed at a cut portion of the tubing at the installing end and the plug 32 being installed in the leading or pull line end after disconnection of the pull line. Each of plugs 30 and 32 has peripheral expanding gasket members 34 arranged for releasable sealing engagement with the pipe 14 and the liner 10a and operated by pressure lines 36, such as air pressure lines, leading to control means above ground. Plug 30 has an inlet conduit 38 therethrough for an expanding material such as live steam or hot water, such conduit having a suitable control valve 40 therein as well as a pressure gauge 42 and relief valve 44. Plug 32 has a discharge conduit 46 communicating with the area between the two plugs and suitably valved at 48. By closing valve 48 in plug 32 live steam or hot water is introduced through plug 30 to provide expansion of the tubing into a liner.

Fig. 6 shows another type of apparatus for expanding the reduced tubing. Such apparatus comprises a mandrel 50 having heating means 52 therein capable of heating the tubing into a pliable state. Mandrel 52 has connection to a pull cable 54 or other means for drawing it through the pipe. Upon proper heating of the mandrel and pulling it through the pipe, it will expand the tubing to the desired diameter liner.

A third method of heating, rerounding and expanding the tubing involves flushing hot water or steam down the pipe to be lined alongside the folded liner until the desired temperature is achieved at the downstream end. Once the desired temperature is reached, the liner is pressurized with hot water and expanded under pressure to fit.

In a specific pipe lining process, conventional PVC tubing is obtained which is a 1/4 inch plus or minus smaller in outside diameter than the inner diameter of the pipe to be lined. The PVC tubing is heated to approximately 210 F. and reduced to the shape shown in Fig. 3. Although the tubing can possibly be used just by flattening it in one plane, as stated hereinbefore, it preferably is flattened and then folded double as shown in Fig. 3 to minimize its overall dimension. The reduced liner can then be stored on large spools so that it can be trucked to the site. When being installed in the pipe, the tubing is again heated so as to be made pliable and capable of being pulled through the pipe to be lined. Thereupon, it is heated, rerounded, and, if desired, expanded. Rerounding and expansion are achieved by plugged areas as illustrated in Fig. 5, physically expanded by a mandrel 50 as shown in Fig. 5, or by the heating and pressurization process described.

It is to be understood that the form of my invention herein shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of my invention, or the scope of the subjoined claims.

CLAIMS

1. A process of lining a pipe comprising the steps of

compressing a tubular member laterally to an overall reduced dimension configuration,

pulling said reduced member through a pipe to be lined,

and then expanding said reduced member in the pipe to serve as a liner.

2. The process of claim 1 wherein said reduced member is folded double prior to pulling it into the pipe for reducing its lateral dimension.

3. The process of claim 1 wherein said tubular member upon being reduced in dimension is wound on a roll and upon being pulled into a pipe is unwound from said roll.

4. The process of claim 1 wherein said tubular member is expanded by a pressured heated fluid forced temporarily therein.

5. The process of claim 1 including the step of plugging opposite ends of the tubular member as installed in the pipe and then forc-

ing pressured fluid between the plugged ends to provide said expansion.

6. A process of lining a pipe with a thermoplastic tabular member comprising the steps of

heating said tubular member a sufficient amount to make it pliable,

reducing the cross section dimension of said tubular member while in its pliable state,

pulling said reduced dimension tubular member through a pipe in a pliable state,

and then expanding said tubular member in the pipe to serve when cooled as a liner.

7. The process of claim 6 wherein said tubular member is folded double prior to pulling it into the pipe for reducing the overall lateral dimension thereof.

8. The process of claim 6 wherein said tubular member upon being reduced in dimension is wound on a roll while in its heated pliable state and is unrolled when pulled into a pipe.

9. The process of claim 6 wherein said tubular member upon being flattened is wound on a roll for storage while in its heated pliable state and is reheated to its pliable state at the time it is pulled into a pipe.

10. The process of claim 6 wherein said tubular member is expanded by a pressured fluid forced temporarily therein.

11. The process of claim 6 including the step of plugging opposite ends of the tubular member as installed in the pipe and then forcing a pressured fluid between the plugged ends to provide said expansion.

12. A process of lining a pipe with a substantially rigid thermoplastic tubular member comprising the steps of

heating said tubular member a sufficient amount to make is pliable,

flattening said tubular member while in its pliable state,

pulling said flattened conduit through a pipe in a pliable state,

and then expanding said tubular member in the pipe to serve when cooled as a tubular liner.

13. The process of claim 12 wherein said tubular member comprises PVC conduit.

14. Apparatus for lining a pipe with a rigid thermoplastic tubing comprising

first heating means arranged to heat the tubing to a temperature which makes it pliable;

shaping means for shaping the pliable tubing into a form which is reduced in cross section;

installing means for inserting said tubing into a pipe to be lined, said installing means comprising heating means for making said tubing pliable, pulling means for pulling said tube into a pipe, and expanding means for expanding said tubing within the pipe whereby when set, said tubing comprises a rigid liner.

15. The apparatus of Claim 14 wherein said expanding means comprises means for admitting a hot fluid under pressure.

16. The apparatus of Claim 14 wherein said expanding means comprises a heated mandrel arranged to be pulled through said tubing.

17. A process of lining a pipe, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

18. A pipe whenever lined by a process as claimed in any one of Claims 1 to 13 or Claim 17.

19. An apparatus for providing a pipe with a lining of a rigid thermoplastic tubing, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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